|  |
| --- |
| Mathematics Design Collaborative |
| State of Georgia Department of Education |



|  |
| --- |
|  |
| Linear and Exponential Functions |
|  |
| *Birthday Gifts and Turtle Problem* |
|  |
|  |
|  |
|  |
|  |
|  |

|  |
| --- |
| INTRODUCTION TO THIS FORMATIVE ASSESSMENT LESSON |

|  |
| --- |
| **MATHEMATICAL GOALS** |
| This lesson unit is intended to help you assess how well students are able to: |
| * Write linear and exponential functions from verbal sentences * Understand the rates of change of linear functions are constant, while the rates of change of exponential functions are not constant. |

|  |
| --- |
| **GEORGIA STANDARDS OF EXCELLENCE** |
| This lesson involves mathematical content in the standards from across the grades, with emphasis on: |
| **MGSE9-12.F.LE.1** Distinguish between situations that can be modeled with linear functions and with exponential functions.  **MGSE9-12.F.LE.1a** **Show that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals. (This can be shown by algebraic proof, with a table showing differences, or by calculating average rates of change over equal intervals).**  **MGSE9-12.F.LE.1b** Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.  **MGSE9-12.F.LE.1c** Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.  **MGSE9-12.F.LE.2 -** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph,a description of a relationship, or two input-output pairs (include reading these from a table). |
| **MGSE9-12.F.LE.3** Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, ~~quadratically, or (more generally) as a polynomial function.~~ |
| * SMP1. Make sense of problems and persevere in solving them. * SMP2. Reason abstractly and quantitatively. * SMP4. Model with mathematics. * SMP6. Attend to precision. |

|  |
| --- |
| **INTRODUCTION** |
| This lesson is structured in the following way: |
| * Before the lesson, students work individually on an assessment task that is designed to reveal their current understandings and difficulties. You then review their work, and create questions for students to answer in order to improve their solutions. |
| * Students are grouped into pairs by common misconceptions. |
| * After a whole-class interactive introduction, students work in pairs on the collaborative discussion task first to match the situation with the mathematical equation, and then to match the graph to the pair. |
|  |

OPTIONAL: teacher may have students create charts of the equations before he/she hands out the graphs.

OPTIONAL: teacher could ask students to do one of the following on chart paper:

* Put cards in order from changing the slowest to changing the fastest
* Put cards in order from increasing the slowest to increasing the fastest.
* For the linear equations, ask students to compute the slope of each line
* For exponential equations, ask students to compute slope between points A and B, then between points B and C, then between points C and D, to note the way that the rate of change is changing. Aim discussions toward Calculus thought (difference quotient…how the slope is more accurate when the points chosen are closer together) for advanced learners.
* Students write their own equations on the blank equation cards for the situations (2) that had no match.
* After a plenary discussion, students return to their original assessment tasks, and try to improve their own responses.
* A different post-assessment task (which is similar to the pre-assessment task) will be administered to determine if growth has been made in understanding linear/exponential equations and their graphs.

|  |
| --- |
| **MATERIALS REQUIRED** |
| Each individual student will need: |
| * A copy of the Pre-Assessment * A copy of the Post-Assessment   Each pair of students will need:   * Chart Paper * Glue Sticks or Tape * Card Sets (Situations, Equations and Graphs) |
| **TEACHER PREP REQUIRED** |
| Teacher will need to cut out Card Sets so the order can be scrambled. |

|  |  |  |  |
| --- | --- | --- | --- |
| **TIME NEEDED** | | | |
| For Pre-Assessment: 15 minutes | For Lesson: 45 minutes | For Post: 15 minutes |
| Timings are approximate. Exact timings will depend on the needs of the class. | | | |

|  |
| --- |
| **FRAMING FOR THE TEACHER:** |
| CCGPS Mathematics compares exponential to linear functions during 9th grade in order for students to understand the difference between a constant rate of change and a non-constant rate of change. These two are chosen for comparison because of the arithmetic vs. geometric link to sequences.  Students learn that a constant difference creates an arithmetic sequence when the domain is comprised of integer values, whereas a constant factor creates a geometric sequence under the same circumstances. This task highlights the differences between the two types of functions and their rates of change. The collaborative activity requires that student understand how to create equations to model situations that may be described by one of these types of functions. |

|  |
| --- |
| **FRAMING FOR THE KIDS:** |
| Say to the students: |
| *This activity will take about one to two days for us to complete.* |
| *The reason we are doing this is to be sure that you understand the difference between linear functions with a constant rate of change and exponential functions with a non-constant rate of change before we move on to a new idea.* |
| *You will have a chance to work with a partner to correct any misconceptions that you may have. After the partner work, you will be able to show me what you have learned!* |

|  |
| --- |
| PRE-ASSESSMENT BEFORE THE LESSON |
| **ASSESSMENT TASK:** |
| Name of Assessment Task: Birthday Gifts and Turtle Problem |
| Time This Should Take: 15 minutes |

Have the students do this task in class or for homework, a day or more before the formative assessment lesson. This will give you an opportunity to assess the work, and to find out the kinds of difficulties students have with it. You will them be able to target your help more effectively in the follow-up lesson.



Give each student a copy of the Pre-Assessment:

Briefly introduce the task and help the class to understand the problem and its context.

*Spend 15 minutes working individually on this task. Read through the task and try to answer it as carefully as you can. Show all your work so that I can understand your reasoning. Don’t worry if you can’t complete everything. There will be a lesson that should help you understand these concepts better. Your goal is to be able to confidently answer questions similar to these by the end of the next lesson.*

***Note: The teacher may consider adding labels to the axes on the coordinate plane if students appear to be struggling with that.***

Students should do their best to answer these questions, without teacher assistance. It is important that students are allowed to answer the questions on their own so that the results show what students truly do not understand.

Students should not worry too much if they cannot understand or do everything on the pre-assessment, because in the next lesson they will engage in a task which is designed to help them.. Explain to students that by the end of the next lesson, they should expect to be able to answer questions such as these confidently.

This is their goal.

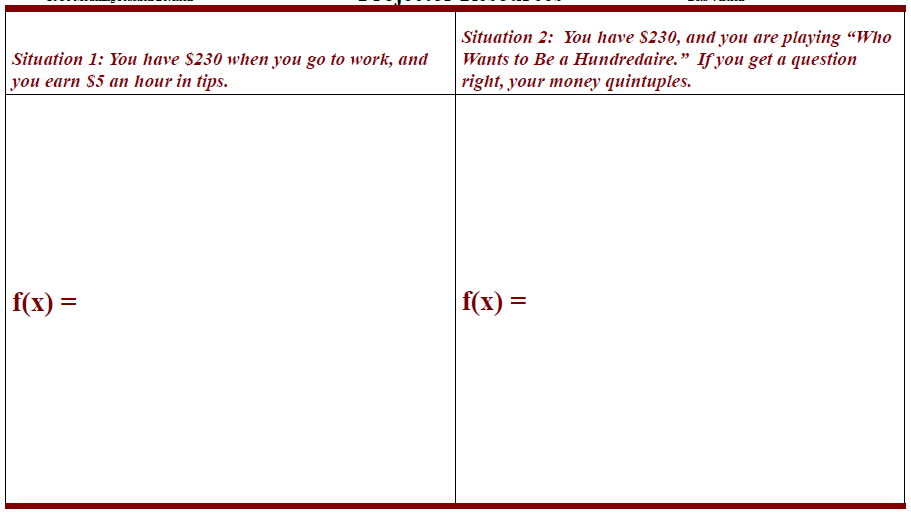
|  |
| --- |
| COLLABORATION TIME/READING STUDENTS RESPONSES |
| **You Will Not “Grade” These!** |
| Collect students’ responses to the task. It is helpful to read students’ responses with colleagues who are also analyzing student work. Make notes (on your own paper, not on their pre-assessment) about what their work reveals about their current levels of understanding, and their approaches to the task. You will find that the misconceptions reveal themselves and often take similar paths from one student to another, and even from one teacher to another. Some misconceptions seem to arise very organically in students’ thinking. Pair students in the same classes with other students who have similar misconceptions. This will help you to address the issues in fewer steps, since they’ll be together. (Note: pairs are better than larger groups for FAL’s because both must participate in order to discuss!)   |  | | --- | | You will begin to construct Socrates-style questions to try and elicit understanding from students. We suggest you write a list of your own questions; however some guiding questions and prompts are also listed below as a jumping-off point. | |

*GUIDING QUESTIONS*

|  |  |  |
| --- | --- | --- |
| **Common Issues** | **Suggested Questions and Prompts** | |
|  |  | |
| **Student Was Unable to Begin Activity**  Example: *I don’t know how to write an equation from a situation.* | * What do you start out with? (i.e. what money do you pay initially how much do you have initially, where are you at first, etc. . . ) * What is changing (variable) in this situation? (i.e. the number of miles, the number of years, the number of chores, etc. . . ) | |
| **Student was Unable to Begin Assessment**  Example: *I don’t know how to put these answers in the chart.* | * If Mary is 10, how much money does she get? According to this situation, how much money will she get next year? * What is different about how Mary’s gift amount increases and how Jane’s gift amount increases? | |
| **Student thinks all graphs are linear**  *Example: only graphs two points of Jane’s gift amount, and then connects those dots.* | * Have you looked to see if all of the points on your chart match this graph? | |
| **Student does not know where the variable goes in the equation**  *Example: Student confuses f(x)=2x+25 with f(x)=25\*2x* | * Which variable is independent? * Which variable is dependent? * Can you plug values in to help you match these? |  |
| **Student does not realize that exponential equations will change very quickly over time.**  *Example: It is obvious that Mary got a better present amount, because she started out with more. No way can a penny change into more than what Mary had at first.* | * What if they lived to 110? How much would each of them receive on their birthday? * Have you checked the last payment they will receive to see? | |
| **Student does not use proper function notation.**  *Example: Student writes y=2x + 25 or y = 25\*2x.* | * Is there another, more proper, notation to use than “y” when writing an equation? | |
| **Student does not realize that 30 minutes or 50 cents is equivalent to the fraction ½.**  *Example: The numbers in this situation aren’t even found in any of these equation cards.* | * What is another word for a 50-cent piece? * What is another way of saying 30 minutes? | |

|  |  |
| --- | --- |
| LESSON DAY | |
| **SUGGESTED LESSON OUTLINE:** | |
| **Part 1: Whole-Class Introduction:** | **Time to Allot: ( 15 minutes)** |
| Display the “Warm Up” question provided. | |
| Suggested Prompts:  *Questions to Ask (Situation 1):*   * *When will the water be all gone?* * *How fast does the water evaporate?* * *What do you multiply by to “half” a quantity of something?*   *Questions to ask (Situation 2)*   * *When will the water be all gone?* * *How fast does the water evaporate?* * *What do you multiply by to “half” a quantity of something?* | |

Below is an extra optional warm up.

**

|  |  |
| --- | --- |
| **Part 2: Collaborative Activity:** | **Time to Allot: (30 minutes)** |
| Do/Say the Following: | |
| * Group students in pairs by common errors found in Formative Assessment “The Birthday Gift Problem” * Post collaborative activity instructions (projector resources, included) * After a whole-class interactive introduction, students work in pairs on the collaborative discussion. First they match the situation with the mathematical equation (functions). * Then they match the graph with the appropriate situation/equation cards. * Students write their own equations on the blank equation cards for the situations (2) that had no match.   The purpose of this structured group work is to ensure that students know how to write linear and exponential equations from real-world situations. This activity demonstrates students’ understandings of how linear and exponential functions are graphed and modeled. The goal is to develop an understanding of the nature of “change” in linear and exponential functions. | |
| During the Collaborative Activity, the Teacher has 3 tasks:   * Circulate to students’ whose errors you noted from the pre-assessment and support their reasoning with your guiding questions. * Circulate to other students also to support their reason in the same way. * Make a note of student approaches for the summary (plenary discussion). Some students have interesting and novel solutions! | |

Note different student approaches to the task and any common mistakes. For example, students may

* Have a tough time getting started with modeling
* They may choose to graph all functions as lines.
* They may not realize that exponential functions change very rapidly over time and that the rates of change differ over time.
* Students may confuse the structure of linear and exponential functions.
* Students may try to match similar numbers together (the cards were created so that this cannot be done, since numbers are repeated, and some numbers are “hidden” in context, such as 30 minutes…students should pick up on this equaling half an hour.

Also *notice the ways students may:*

* Use improper notation. Correct this error with “is this proper function notation?”
* Over-simplify exponential graphs by only showing two points
* Be disturbed that their graph in the pre-assessment won’t hold all of the domain points because the amounts are too high. Reassure them (later) that this happens all the time. Just go with it. We cannot always predict at the beginning of graphing what the graph will look like, and if we could, there would be no need to graph.

You can use this information to focus a plenary whole-class discussion.

**Support Student Reasoning**

Try not to make suggestions that steer students towards a particular “correct” answer or response. Instead, ask questions to help students to reason together.

If you find one student has produced a correct response, challenge another student in the group to provide an explanation.

*Example:*

*Sherry, why do you think that this situation is exponential rather than linear?*

*John, what tells you that the y-intercept is this number?*

*Hal, how can you tell where the variable goes in this equation?*

If you find students have difficulty articulating their decisions, use the sheet Suggested questions and prompts to support your own questioning of students.

*Sample ways to jump-start students’ work in the group collaboration:*

* *Can you narrow down any that seem linear?*
* *Can you rule out any that definitely do not go together?*
* *What is the starting value or amount?*

If the whole class is struggling on the same issue, you could write a couple of questions on the board and hold an interim, whole-class discussion. You could ask students who performed well in the assessment to help struggling students.

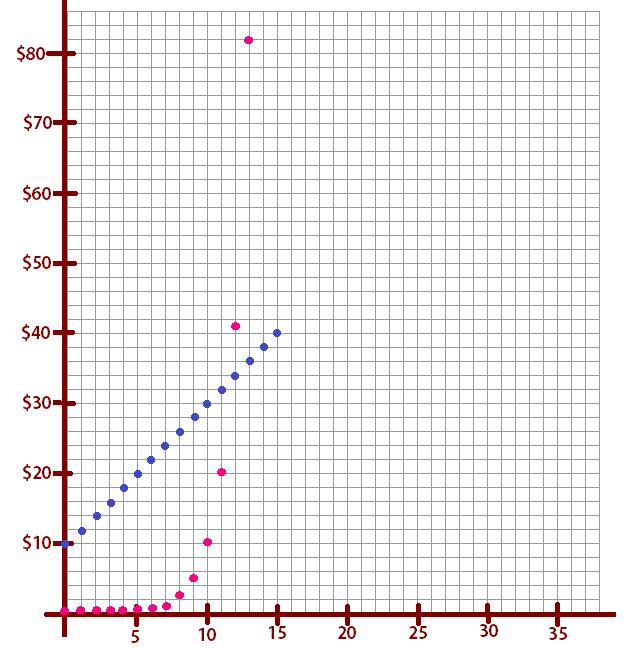
|  |  |
| --- | --- |
| **Part 3: Plenary (Summary) Discussion:** | **Time to Allot: ( 15 minutes)** |
| Gather students together, share solutions. Discussion prompts should be made up of your original guiding questions and notes about student approaches. Some other discussion prompts are listed below: | |
| NOTE: *“Scribing” helps to increase student buy-in and participation. When a student answers your question, write the student’s name on the board and scribe his/her response quickly. You will find that students volunteer more often when they know you will scribe their responses – this practice will keep the discussions lively and active!* | |
| Bring the class together and use the following to guide discussion:   * *How can you tell if the situation is exponential or linear? What clues do you look for?* * *How can you tell if a graph is exponential or linear?* * *Where do you find the “initial value” in exponential equations?* * *Where do you find the “initial value” in linear equations?* * *Where do you find the “initial value” in exponential graphs? Linear graphs? All graphs?* | |

|  |  |
| --- | --- |
| **Part 4: Improving Solutions to the Assessment Task** | **Time to Allot: (15 minutes)** |
| The Shell MAP Centre advises handing students their original assessment tasks back to guide their responses to their new Post-Assessment (which is sometimes the exact same as the Pre-Assessment). In practice, some teachers find that students mindlessly transfer incorrectt answers from their Pre- to their Post-Assessment, assuming that no “X” mark means that it must have been right. . Until students become accustomed to UNGRADED FORMATIVE assessments, they may naturally do this. Teachers often report success by handing students a list of the guiding questions to keep in mind while they improve their solutions.  Practice will make perfect, and teachers should do what makes them most comfortable with their students/finds and kills misconceptions! | |
| Return to the students their original assessment task if you choose (some teachers choose not to return the original assessment task because students tend to just copy the old answers without realizing that they had incorrect answers previously; they misinterpret a lack of “X” marks as meaning they got the problems all correct – it may be worthwhile to mention to students who are new to FAL’s that the lack of an “X” does not mean they got it right if you do choose to give students their original tasks back).  *Look at your original responses and think about what you have learned this lesson.*  *Using what you have learned, try to answer the questions on this*  *new assessment. The situation and questions are different, but*  *the same basic concepts are used..*  If you have not added questions to individual pieces of work then write your list of questions on the board or hand out copies of the questions.  Students should select from this list only the questions they think are appropriate to their own work.  Give students a blank copy of the post assessment task “Turtle  Repopulation.” They may use their original pre-assessment task to help, if the teacher wishes. | |
|  | |

|  |
| --- |
| PRE-ASSESSMENT (Answer Key) |
| **ASSESSMENT TASK:** |
| Name of Assessment Task: |
| **The Birthday Gift Problem**    Twins Mary and Jane’s parents have created a birthday gift policy whereby Mary receives $10 on her 10th birthday, and each birthday thereafter, she gets a $2 raise. So on her 11th birthday, she received $12, and on her 12th birthday, she received $14, and so on, until her 30th birthday. Their parents gave Jane, on the other hand, a penny on her 10th birthday. When she turned 11, she received two pennies, and when she turned 12, she received four pennies. Your parents say they will continue this pattern until her 30th birthday. When the twins asked if it was a fair policy, the parents said “Yes, unless you can prove otherwise.”  Use the chart below to calculate the amount gifted to Mary and Jane each year.   |  |  |  |  | | --- | --- | --- | --- | |  |  | Mary’s | Jane’s | | Age | Year | Gift | Gift | | 10 | 0 | *10* | *.01* | | 11 | 1 | *12* | *.02* | | 12 | 2 | *14* | *.04* | | 13 | 3 | *16* | *.08* | | 14 | 4 | *18* | *.16* | | 15 | 5 | *20* | *.32* | | 16 | 6 | *22* | *.64* | | 17 | 7 | *24* | *1.28* | | 18 | 8 | *26* | *2.56* | | 19 | 9 | *28* | *5.12* | | 20 | 10 | *30* | *10.24* | | 21 | 11 | *32* | *20.48* | | 22 | 12 | *34*  40.96 | *40.96* | | 23 | 13 | *36* | *81.92* | | 24 | 14 | *38* | *163.84* | | 25 | 15 | *40* | *327.68* | | 26 | 16 | *42* | *655.36* | | 27 | 17 | *44* | *1310.72* | | 28 | 18 | *46* | *2621.44* | | 29 | 19 | *48* | *5242.88* | | 30 | 20 | *50* | *10,486.76* | |  |  |  |  | |

Teacher Guide Beta Version

Graph both situations on the same axes, below. Take care to label your graph.



* 1. How much money will each twin receive on their 15th birthday?

The 15th birthday is x = 5.

*Mary receives $20 and Jane receives $0.32.*

* 1. Are the policies fair to Mary and Jane? If not, who got a better deal?

*Even though teachers know that fair is not always equal, this is not fair. Mary receives more money at first than Jane, but after about 12 years, Jane’s gifts are far more than Mary’s.*

* 1. Could there be future problems? Explain.

*Besides fighting between Mary and Jane, their parents may need to save money. By the last year, they need more than $10,000 to give to Jane!*

* 1. Write the equation for each gifting policy. (Make sure to tell what each variable stands for).

*M(t)=2t+10 {t = time in years, M(t) = amount of money received by Mary)*

*J(t) = 10\*(2t) {t = time in years, J(t) = amount of money received by Jane)*

1. Will Mary and Jane ever receive the same (or close to the same) amount on their birthdays?

*On their 22th birthday, they receive amounts that are only $6.96 apart. That’s the closest they ever come.*

|  |
| --- |
| Collaborative Activity (Answer Key) |
|  |
| ***SOLUTIONS TO MATCHING in the COLLABORATIVE ACTIVITY***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  | **SITUATIONS IN WORDS** |  | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **I** | **J** | |  |  |  |  |  |  |  |  |  |  |  |  |  | **x** | |  |  | **MATH SENTENCES** |  | **f(x)** | **q(x)** | **h(x)** | **n(x)** | **k(x)** | **r(x)** | **m(x)** | **w(x)** | **f(x) = 2x+5** | **f(x) = 5(2)** | |  |  | **GRAPHS** |  | **9** | **3** | **5** | **7** | **8** | **4** | **10** | **2** | **1** | **6** |   POST-ASSESSMENT (Answer Key)  **The Turtle Problem**  Veterans Island and The Isle of Northside both have an indigenous population of endangered turtles. In 2012, both islands had an initial population of 200 endangered turtles. The repopulation project initiated by scientists Brown & Peavy looks quite promising. At Veterans, the turtle population increases by 500 turtles per year, while at Northside, the population of turtles doubles each year.   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  | At Veterans… |  |  | At Northside… |  |  | | |  |  |  |  |  | | Starting Population |  | 200 turtles in 2012 | |  | 200 turtles in 2012 | | |  | | Rate of Turtle Growth per Year. The population…. |  | increases 500 per year | |  | doubles each year | | |  |   Graph both on the same axes, below. Take care to label your graph, show the incremental units of measure that you used, and round as appropriate for your population numbers. Indicate which graph is which.   |  |  |  |  | | --- | --- | --- | --- | | Calendar  Year | Year | Veterans  Island | Isle of  Northside | | 2012 | 0 | 200 | 200 | | 2013 | 1 | 700 | 400 | | 2014 | 2 | 1200 | 800 | | 2015 | 3 | 1700 | 1600 | | 2016 | 4 | 2200 | 3200 | | 2017 | 5 | 2700 | 6400 | | 2018 | 6 | 3200 | 12,800 | | 2019 | 7 | 3700 | 25,600 | | 2020 | 8 | 4200 | 51,200 | | 2021 | 9 | 4700 | 102,400 | | 2022 | 10 | 5200 | 204,800 | |  |  |  |  | |

POST- ASSESSMENT page 2 of 2

1. What will the population of turtles on each island be after 5 years?

*Veterans turtle population will be 2700 Isle of Northside will have 6400*

1. Which island saw the greatest change in turtle population?

*Isle of Northside showed the greatest change from 200 to 204,800 over a ten year period.*

1. Is it possible that the most effective repopulation program may experience future turtle problems? Explain. *Eventually, the resources of the Isle of Northside could not support the turtle population growth any longer. Animals living in close proximity to one another tend to spread disease. Animals that are plentiful also take resources from other animals, and therefore the population growth of turtles may cause extinction of another species. The model does not mention death of turtles and so it may not be 100% accurate over long periods of time. However, turtles do live a very long time….*

4. Write the equation for each island. Include a legend for each of your variables!

Veterans Island *p(t) = 500(t) + 200* t = time in years, p(t) = turtle population

Isle of Northside t = time in years, p(t) = turtle population

**The Birthday Gift Problem**



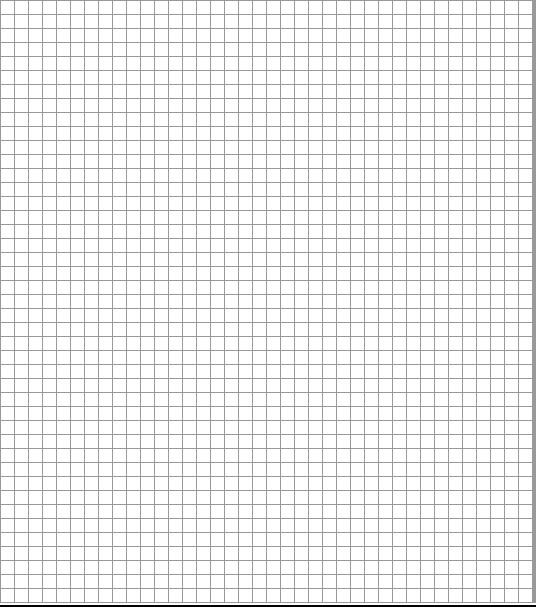
Twins Mary and Jane’s parents have created a birthday gift policy whereby Mary receives $10 on her 10th birthday, and each birthday thereafter, she gets a $2 raise. So on her 11th birthday, she received $12, and on her 12th birthday, she received $14, and so on, until her 30th birthday. Their parents gave Jane, on the other hand, a penny on her 10th birthday. When she turned 11, she received two pennies, and when she turned 12, she received four pennies. Your parents say they will continue this pattern until her 30th birthday. When the twins asked if it was a fair policy, the parents said “Yes, unless you can prove otherwise.”

Use the chart below to calculate the amount gifted to Mary and Jane each year.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  | Mary’s | Jane’s |
| Age | Year |  | Gift | Gift |
| 10 | 0 | |  |  |
| 11 | 1 | |  |  |
| 12 | 2 | |  |  |
| 13 | 3 | |  |  |
| 14 | 4 | |  |  |
| 15 | 5 | |  |  |
| 16 | 6 | |  |  |
| 17 | 7 | |  |  |
| 18 | 8 | |  |  |
| 19 | 9 | |  |  |
| 20 | 10 | |  |  |
| 21 | 11 | |  |  |
|  |  | |  |  |
|  |  | |  |  |
|  |  | |  |  |
|  |  | |  |  |
|  |  | |  |  |
|  |  | |  |  |
|  |  | |  |  |
|  |  | |  |  |
|  |  | |  |  |
|  |  |  |  |  |

Graph both situations on the same axes, on the next page. Take care to label your graph.

**The Birthday Gift Problem**



1. How much money will each twin receive on their 15th birthday?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Are the policies fair to Mary and Jane? If not, who got a better deal?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* 1. Could there be future problems? Explain.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

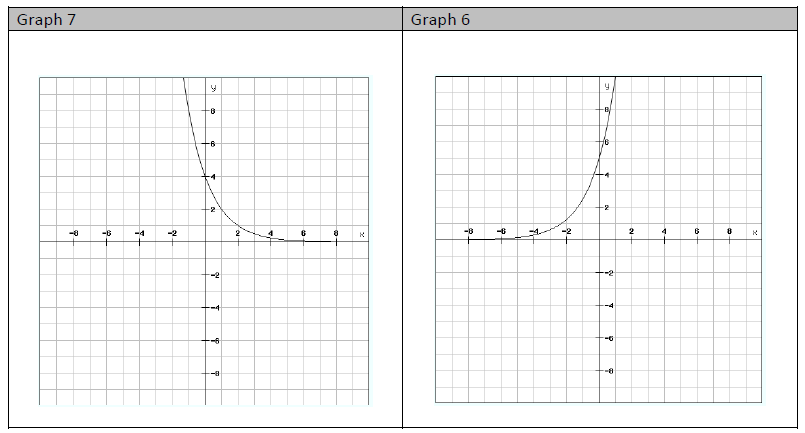
* 1. Write the equation for each gifting policy. (Make sure to tell what each variable stands for).

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Will Mary and Jane ever receive the same (or close to the same) amount on their birthdays?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |
| --- |
| COLLABORATIVE ACTIVITY |
| Name of Assessment Task: Card Match Card Set 1 : A-J |
| |  |  | | --- | --- | | f(x)=3x+4 | q(x) = 4\*3x | |  |  | | h(x)=(1/2)x+4 | n(x) = 4(1/2)x | |  |  | | k(x)=4x+3 | r(x) = 3\*4x | |  |  | | m(x)=4x+1/2 | w(x) =(1/2)4x | |  |  | |  |  |   Card Set 2 |  |  |  |  |  |
| Card Set 3 | Situation C |  |  |  | Situation D |
|  |  |  |  | You are four miles from your date's house. |  |
|  |  |  |  | You walk half the distance there. Then you |  |
|  |  |  |  | you walk half of the remaining-remaining |  |

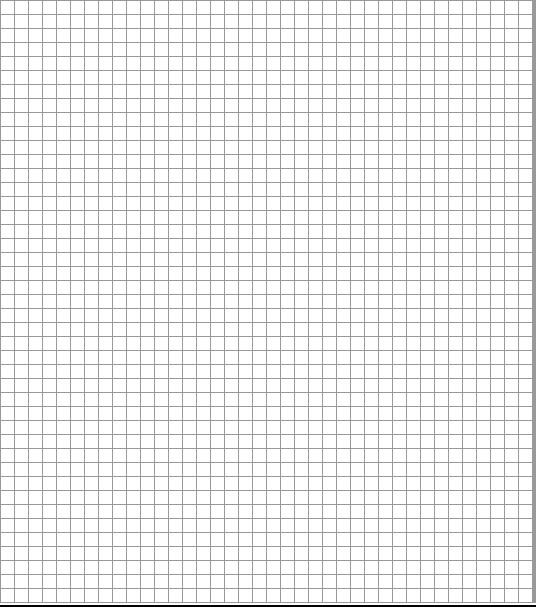


**The Turtle Problem**

Veterans Island and The Isle of Northside both have an indigenous population of endangered turtles. In 2012, both islands had an initial population of 200 endangered turtles. The repopulation project initiated by scientists Brown & Peavy looks quite promising. At Veterans, the turtle population increases by 500 turtles per year, while at Northside, the population of turtles doubles each year.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | At Veterans… |  |  | At Northside… |  |  |
|  |  |  |  |  |  |
| Starting Population |  | 200 turtles in 2012 | |  | 200 turtles in 2012 | |  |
| Rate of Turtle Growth per Year. The population…. |  | increases 500 per year | |  | doubles each year | |  |

Graph both on the same axes, below. Take care to label your graph, show the incremental units of measure that you used, and round as appropriate for your population numbers. Indicate which graph is which.



|  |  |  |  |
| --- | --- | --- | --- |
| Calendar  Year | Year | Veterans  Island | Isle of  Northside |
| 2012 | 0 | 200 | 200 |
| 2013 | 1 |  |  |
| 2014 | 2 |  |  |
| 2015 | 3 |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

page 2 of 2

1. What will the population of turtles on each island be after 5 years?

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

2. Which island saw the greatest change in turtle population?

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1. Is it possible that the most effective repopulation program may experience future turtle problems? Explain.

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

4. Write the equation for each island. Include a legend for each of your variables!

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

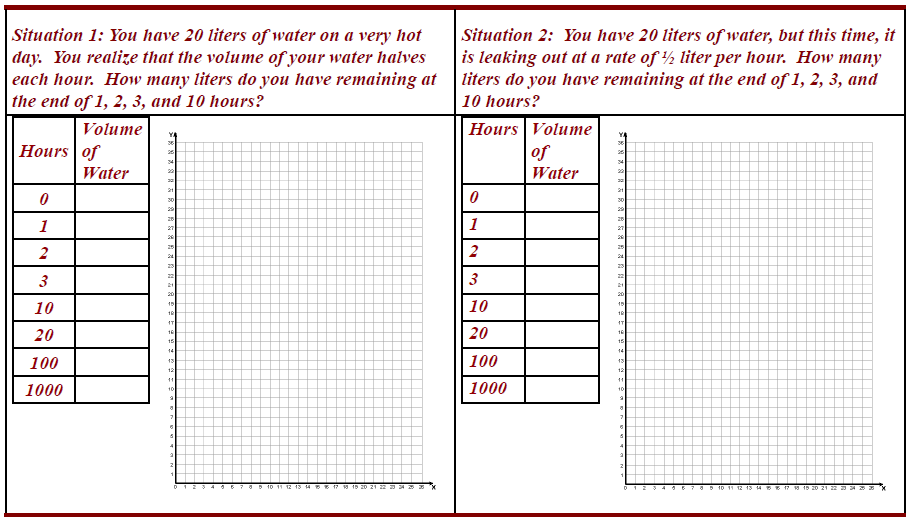
**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_**

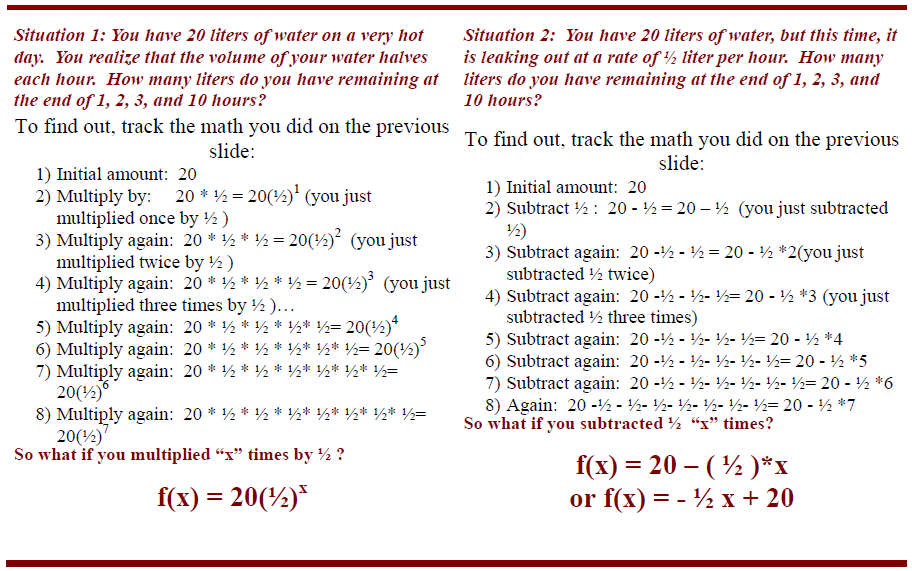
**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

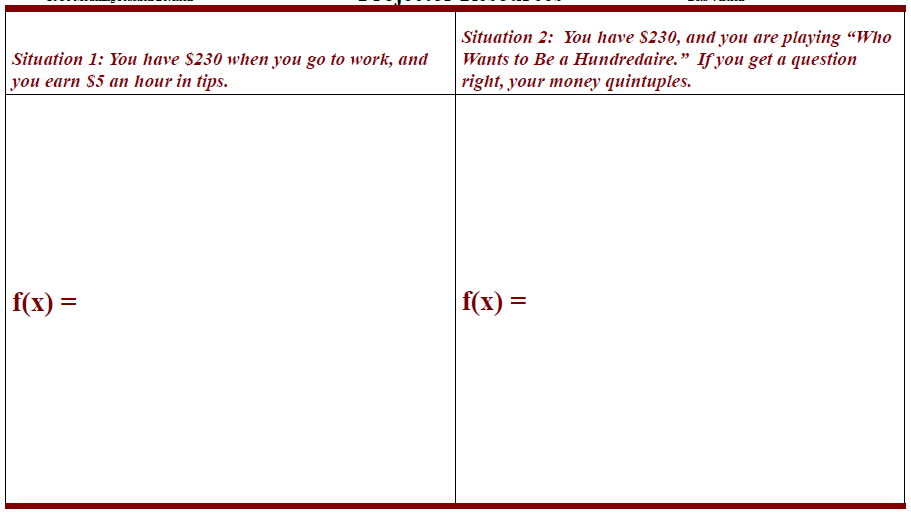
**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

****

****

****

